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Traffic Sign Recognition System: A Survey

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Abstract - *Traffic signs usually provide information about the road ahead to the drivers. Traffic signs mainly are of three types: Mandatory, Cautionary and informatory signs [10]. In some areas, environmental conditions are not that propitious such as; hilly areas, fog, shadows, tree branches, etc. In these circumstances, the traffic sign is not clearly visible and if the driver is not aware of the road conditions ahead, any mishap can come about. Suppose the road ahead is a steep slope and the driver is driving at the speed of 60 km/h or above, this may lead to a catastrophe. Many existing systems cater to these kinds of conditions. Video sequences are captured by a camera mounted on the car or the bike. Most existing systems consist of three stages, traffic sign region of interest (ROIs) extraction, ROIs refinement and classification, and post-processing. ROIs from each frame are first extracted using maximally stable extremely regions on gray and normalized RGB channels. In some systems, an additional step is included where the image is passed through some kind of filter. This filter removes any kind of noise so that the job of the classifier gets easy. Either the image is denoised using a Gaussian filter or a spatial filter. Then, they are refined through various neural network layers and assigned to their potential classes via multi-layer neural network, which is trained with a huge amount of database which includes synthetic traffic signs and images taken from RTO labeled from street views. The post-processing finally combines the results in all frames to make a recognition decision based on their probabilities. These systems are useful in wild life or forest areas, and also when the region is foggy and it becomes difficult to figure out the traffic sign. Traffic sign recognition systems noted below have provided unique solutions. Below provided content is an overview of some of the possible ways to adopt new ways for traffic sign recognition. The results are communicated either using audio or a visual representation on the driver's mobile or on the display embedded inside the dashboard of the car, whichever is convenient to the driver.*

Key Words: ROIs(Region of interests), neural networks, Traffic sign recognition, gray and normalized RGB levels, ROI extraction, ROI refinement, ROI classification, denoising techniques, filters, Computer Vision, Parallel computing.

1. INTRODUCTION

Most of the time whenever a driver is driving a car, he gets so engrossed in driving that he tends to ignore the traffic signs that are present on either sides of the road .This may lead to a problem or may also lead to an accident, if the traffic sign says that there is a sharp turn or it's a valley area and the driver ignores the sign and still doesn't lower his speed. In order to prevent such misfortune a system that automatically identifies these signs is proposed, in this the pre-processing is done and the output of the sign is displayed on the speedometer of the car, which tells the driver well in advance which sign he is crossing by and thus any unwanted event is prevented. Traffic sign's data can also be taken from GPS, but this method is not reliable as it is not updated frequently.

The problem of real-time traffic sign recognition in the Wild has to be solved to meet the growing need of automatic driving. The traffic sign recognition usually consists of two steps: traffic sign detection and traffic sign classification. A lot of work has already been done in this field. Most of them have trained their systems according to their country's language as most existing systems focus on traffic sign which contains text like stop, exit, etc. Accuracy and speed are surely the two main requirements in practical applications. Although lots of relevant approaches have been presented in previous work, no one can solve the traffic sign recognition problem very well in conditions of different illumination, motion blur, and occlusion and so on. So, more effective and more robust approaches need to be developed. As for the task of traffic sign detection, existing approaches have achieved good results on some benchmark databases. Next to 100% recall is claimed in some existing work and it seems that the problem has been solved.

Unfortunately, the problem has not been solved and has remained difficult for the limited representation of databases. Accidents relating to these kinds of situations are increasing day by day in the regions where traffic signs are not visible or the signs are mostly not noticed by the driver. The existing systems give novel and quirky solutions for all these problems.

2. GOALS AND OBJECTIVES

The main objective of this paper is to detect traffic signs on the road efficiently and beforehand, so as to eliminate any chance of misfortune. The goals of the systems are as follows:

• To detect traffic signs even in unfavourable conditions.
• To provide an easy approach based on colour and shape information for the localization refinement of small traffic signs is proposed, improving the detection quality and the classification accuracy of typical traffic signs.
• To refine and classify the captured image of the traffic sign accurately.
• To inform the driver about the traffic sign ahead well in advance so that he/she can take appropriate measures.
• To compare various techniques and methods used in previous systems for traffic sign recognition system.

3. MOTIVATION

There are many cases of accidents now-a-days where the driver ignores the traffic signs present on either side of the road or in some cases the traffic sign are covered by a tree branch or fog or something else, which eventually leads to an accident. In areas where there are schools, traffic signs there warn the driver that there is a school ahead and he needs to slow down his speed. In some cases, the sign says that there is a probability of presence of some kind of species ahead viz; tiger, lion, bear, etc. Suppose if the sign says a particular species, which is on the verge of extinction can be found ahead and if the driver ignores it or is not able to properly see it, the life of the driver or the species can be in danger. In such cases when the driver ignores such traffic signs not only his, but pedestrian's life is also risked. So to avoid such mishap, various types of systems are discussed.

4. LITERARTURE SURVEY

The system discussed in [1] by A. Ruta, F. Porikli, S. Watanabe, and Y. Li proposes an idea where mean shift clustering is used. The mean shift refinement is done to find out the modes of underlying distribution. Here, they try to reduce the number of false positives and increase the accuracy. The image captured is fed to a fast, application specific quad tree focus operator which helps in irrelevant features extraction from the image. But for this the whole image is processed, i.e., pixel by pixel. This requires huge amount of memory for processing as well as for storing those images. Now talking about the real time detection, if the camera has a resolution of 480p then to it will require much more memory and time to compute. AdaBoost or SimBoost algorithms are used for classification.
C. Premsai and Prof. A. Kavya [2] try to propose a system which uses graph based ranking and segmentation. This system uses Support Vector machine (SVM). The system consists of three stages: 1) Segmentation according to their color of pixel; 2) Traffic-sign detection may be shape classification using linear SVM; 3) Content recognition is based on Gaussian-kernel SVs. The system uses a graph based segmentation in which the images are ranked according to their saliency and then segmentation takes place after this SVM classifies the image. An insightful view in [3] deliberates about a system which It uses Viola-Jones detector algorithm. It is based on cascade of boosted Haar's features. The algorithm works by sliding a detection window across an image and at with each slide the classifier classifies whether the image inside the sliding window is the desired image or not. Boosting in Haar's feature is done by Adaboost algorithm. Performance depends upon the scale factor.
Traffic sign detection system in [4] suggests a method by integrating color invariants based image segmentation and pyramid histogram of oriented gradients (PHOG) features based shape matching. First, we segment the image into different regions by clustering color invariants, PHOG is used to represent shape features and SVM is used to classify the image. The solution provided in [5] by Samuele Salti, Alioscia Petrelli, Federico Tombari, Nicola Fioraio, Luigi Di Stefano proposes a system which can detect traffic signs in different illuminations and different occlusions. First this system preprocesses the captured image and enhances the traffic sign region and fades background. Then a linear contrast stretching is applied on RGB channels. Further, contrast stretching step is applied to the resulting one channel image (1CHCS). After the interest regions are extracted, HOG and SVM classification are done to accurately classify them accordingly. Finally, two filters help further pruning out false positives: a generative context-aware filter discards regions that are unlikely to correspond to traffic signs given the relationship between their size and their position in the image. The system in [6] is used to detect triangular, diamond, circular, square and octagonal traffic signs. Operates on the gradient of grey-scale picture. It first detects what shape the traffic sign is, by considering only the shape intact and the background is removed. As it uses the concept of symmetry it tries to find out the center of the polygon detected. Each non-gradient pixel votes for a potential centroid. Then the classifier is used to classify the image based on the previously fed images in database.

Table-1: Comparative study

Sr. no	Paper Title	Conclusion
1	In-vehicle camera traffic sign detection and recognition	The system uses various methods to get the correct result but during the feature extraction each and every pixel of the image has to be processed. System gives relatively less accuracy.
2	Traffic sign detection via graph based ranking and segmentation algorithms	Results show a high success rate for an very low amount of false positives and final recognition stage. Relatively higher accuracy than the rest. The performance of color based traffic sign detection approach is often reduced in weather conditions.
3	Real-time detection and recognition of road traffic signs	As the performance depends upon the scale factor, if we reduce it, we increase the probability of the desired image to be found in the window but enlarged window image means more pixels and that means more computation. So there is a trade-off between computation requirements and accuracy.
4	Novel traffic sign detection method via color segmentation and robust shape matching	This system is used to detect only triangular, diamond and circular shapes, but can detect all these categories in various conditions like weather conditions, shadows and partial occlusion.
5	Traffic sign detection via interest region extraction	The system is able to yield nearly optimal performance on two classes and very good results on the most challenging class of mandatory signs. The pipeline system proposed helps in deploying it in real-time situations.
6	Fast Shape-based Road Sign Detection for a Driver Assistance System	It has less accuracy as directly jumps into detecting the shape of the sign in the captured image. The classification work is not properly focused on.

5. GENERAL ALGORITHM OF EXISTING SYSTEMS

Step 1: Camera installed on the vehicle continuously takes the video of the situation ahead.
Step 2: Verify the information into database.
Step 3: traffic sign regions of interest (ROIs) extraction, ROIs refinement and classification, and post-processing.
Step 4: First, for each frame in the video, traffic sign ROIs are detected with Maximally Stable external Regions (MSERs) on multi-channel images.
Step 5: Then, to refine and classify the ROIs, a multi-task Probabilistic Neural Network (PNN) is proposed.
Step 6: Specifically, the ROIs are first fed to a binary classification layer, and only the positive ones are further classified with a deep multiclass classification network.
Step 7: The network is trained end-to-end with a large number of data, which consists of training data, synthetic signs and images labeled from street view.
Step 8: Finally, recognition results from each frame are fused to get the final results of the video.
Step 9: As per comparison show Result.

5. OUTCOME

Traffic sign detection is a challenging task, be it in case of manned vehicle or driver assistance systems. The above mentioned systems propose various solutions to this problem. Proposed methods mainly include interest area extraction, resultant refinement and classification either by neural networks, HOG classification or SVM classification. Allows drivers/driver assistance systems to effectively recognize vital traffic signs. Reduce road accidents or tragedies, facilitate towards road safety and environment friendliness. In some way or the other, existing systems help

in recognizing traffic sign, some of them take relatively more time to process the captured image and some of them inform the driver about the traffic sign well in advance.

6. CONCLUSION

From the above conducted study we can conclude that Traffic sign detection/recognition systems mainly comprises of three stages where in the first stage the required part of the whole image is extracted (ROI extraction), the second phase consists of refine the ROI so as to get the accurate result and the last stage is where the image extracted is classified to an appropriate class label. Most of the systems have proposed many ideas about the sign recognition problem, but the main pitfalls due to the computation. Storing such a huge database and processing each and every pixel (not in every system) is a very sluggish job where a lot of time as well as memory are consumed.

However, the recall of traffic signs requires further improvement. According to the evaluation results of each system, we believe that the performance will be boosted obviously, provided that more annotated data is used. The approach for the localization refinement of bounding box is designed for specific categories of traffic signs and is not robust enough, which will be further studied in our future work.

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